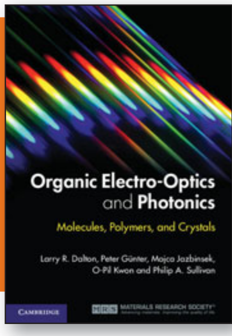


Organic Electro-Optics and Photonics: Molecules, Polymers, and Crystals

Larry R. Dalton, Peter Günter, Mojca Jazbinsek, O-Pil Kwon, and Philip A. Sullivan

Materials Research Society and Cambridge University Press, 2015, 300 pages, $79.99 (e-book $64.00), ISBN 978-0-521-44965-6

In the interest of transparency, MRS is a co-publisher of this title. However, this review was requested and reviewed by an independent Book Review Board.

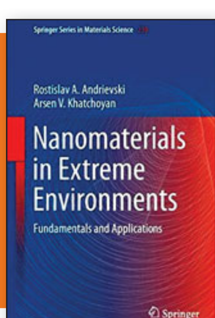
This book provides insight into organic electro-optic materials, from fundamental physics to practical applications. The authors focus on the importance of "photonic integration" as the next step in the long-term development of these materials for computing, telecommunications, and related technologies. This book gives guidance on structure–property relationships needed to improve device performance. It emphasizes second-order nonlinear optical effects in organic materials and their applications.

Chapter 1 provides a history and introduction to nonlinear optical phenomena. Chapter 2 presents the basic theory of the nonlinear optical response, including the nonlinear wave equation and second- and third-order nonlinearities. Chapter 3 focuses on electro-optic phenomena. Topics discussed include the electro-optic effect, frequency and wavelength dependence, and electro-optic modulation. Chapter 4 gives the theory of nonlinear optics from a molecular perspective and experimental techniques for measuring nonlinearities. This chapter also discusses approaches to the design and synthesis of organic electro-optic chromophores. Chapter 5 discusses self-assembled acentric materials, including Langmuir–Blodgett, solution-deposited, and vapor-deposited films. Chapter 6 covers crystalline materials, including crystal-growth methods. There is a discussion of the most promising organic electro-optic crystals.

Chapter 7 focuses on poled polymer systems and discusses optical loss and thermal and photochemical stability. There is a detailed discussion of device fabrication, including silicon photonic, plasmonic, and photonic-crystal hybrid devices. Chapter 8 reviews the device parameters and materials requirements for applications, including telecommunications, computing, and plasmonic devices. Chapter 9 covers electro-optic waveguides, switches, and modulators. There is a description of stripline and resonant electro-optic device structures. There are detailed closed-form solutions of light propagation in slab waveguides and one-dimensional photonic crystals. Chapter 10 focuses on other second-order nonlinear optical effects, including frequency doubling, optical rectification, and difference-frequency generation. Chapter 11 deals with the photorefractive effect and materials, giving detailed theoretical models and methods for measurement of photo-induced refractive index changes. Chapter 12 provides conclusions and projections for the future, forecasting that all-organic devices will evolve into devices integrating organic materials into silicon architectures.

The book reflects the authors' multidecade experience in organic nonlinear optical materials and has very useful comparisons of organic and inorganic materials and the impact of competing technologies. The strengths and weaknesses of organic nonlinear optical materials are presented, where performance is rapidly improved by new materials development, but commercialization is limited by cost and engineering improvements of competing inorganic materials. There are close to 800 references, and extensive materials and figure-of-merit tables are provided. This book is useful as a reference book for researchers and graduate students interested in all aspects of organic nonlinear optics.

***Reviewer: Thomas M. Cooper** of the Air Force Research Laboratory, USA.*



Nanomaterials in Extreme Environments: Fundamentals and Applications

Rostislav A. Andrievski and Arsen V. Khatchoyan

Springer, 2016
107 pages, $99.00 (e-book $69.99)
ISBN 978-3-319-25329-9

This slim volume is an extensive review of the current understanding of the response of nanostructured materials to extreme operating conditions, such as high temperature, flux of high-energy neutrons, high pressure, mechanical stress, and oxidizing environments. The emphasis is on metallic materials, especially Cu alloys. Graphene-based materials, fullerenes, polymeric materials, nanoglasses, and glass ceramics are not covered.

The book has six chapters, including an introduction and a brief conclusion. The introduction documents the growth of scientific interest in nanostructured materials and stresses the need to study the behavior of nanomaterials under extreme conditions. This chapter also presents Herbert Gleiter's classification of nanomaterials into 12 groups based on the shapes of the nanoscale features and chemical composition of the components of the nanostructure. Chapter 2 deals with the

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